

tial parallelism, same-ways orientation, of the structural units, and to develop systematically in stages, starting from parallelism in the holohedral class of a crystal system, the possibilities of alternation and other forms of partial parallelism. The idea is justified from two points of view, first, that of the simplification for the student, who can readily construct the fourteen models of the Bravais space-lattices, by means of knitting needles and spherical balls impaled on them, and indicate on them if he chooses the stages of parallelism, corresponding to the various classes, by means of little inclined rods or other devices for indicating differences in the nature of the nodes of the space-lattice; and secondly, from the point of view of the undoubted importance of the space-lattice as regards crystal structure, and the fact that the space-lattice represents the arrangement of the molecules, while the Sohnckian points clustered around its nodes represent the arrangement of the atoms, and that models of such Sohnckian systems of points are very difficult to construct.

An excellent series of stereoscopic photographs of the fourteen space-lattices are given, forming quite a feature of the book, the photographs not merely representing the spherical balls on the steel rods but the shape in stereographic projection of the solid formed by the elementary cell or unit "brick" of the crystal edifice. The photographs were taken from models in the laboratory of Prof. von Groth at Munich. It is interesting to note also that the system of closest packing, as used by Pope and Barlow, is adopted in the book.

After a few pages of instruction in the elementary facts and nomenclature of crystallography, the author passes on to compare holohedral and partial symmetry, and shows how by placing a short inclined stroke, rod, or bar at each point of intersection or node of a space-lattice, and doing so either parallel-wise or in an alternately arranged manner, the idea of parallelism or otherwise, and even of a screw arrangement, may be indicated directly on the space-lattice itself, the disposition of the cluster of Sohnckian points about each node of the space-lattice being thus indicated by the mode of arranging the little stroke or rod. It is shown that such an arrangement fulfils Wiener's principle, that homogeneity consists in the continual repetition throughout space of the same relation between an elementary atom and the entire structure. The diagrams in the second part of the book indicate how this idea of constructing all the variations of class symmetry of a crystal-system on separate models of the same space-lattice can be carried out, and the book is well worth attention on account of the simplification which it thus presents of the admittedly most difficult part of crystallography. The difference between right- and left-handed mirror-image forms is also very clearly brought out.

While the particular mode of applying these ideas of Prof. Sommerfeldt is new, it can scarcely be said that the principle is. For Mr. Barlow long ago employed models of the human hand at the nodes of the space-lattice, or about them, to indicate orienta-

tional differences of the atomic cluster which each such node represents. But the present mode of differentiation employed by the professor of mineralogy of Tübingen has the especial merit of emphasising in an unmistakable manner the importance of the space-lattice as the fundamental basis of crystal structure.

A. E. H. T.

MODERN EXPLOSIVES.

Les Explosifs modernes. By Paul F. Chalon. Troisième édition. Pp. 787. (Paris: Librairie Ch. Béranger, 1911.) Price 25 francs.

THIS volume is really an encyclopædia on the subject of explosives, although many of the materials described, however interesting, are scarcely to be regarded as explosives, for it is only in very exceptional circumstances that they can behave as such or enter into the composition of explosive mixtures.

The book is divided into five parts, dealing respectively with (i.) explosive substances and the primary materials employed in the industry; (ii.) the manufacture of powders and explosives; (iii.) pyrotechny; (iv.) the methods of employing powders and explosives; (v.) employment of explosives for mining and various other applications; (vi.) legislation.

It would indeed be difficult to turn to the book for information on any substance which has either been employed or suggested for use as an explosive for any purpose, and the author has certainly carried out the descriptive part of the work in a thorough manner, the recent improvements in manufacture, for example, with guncotton and nitroglycerine at Waltham Abbey, being satisfactorily dealt with.

No doubt the author as a mining engineer feels the necessity of including much matter which is familiar to the chemist or manufacturer, such, for example, as the percentage composition of common salts, the different series of hydrocarbons, alcohols, &c., but it is to be regretted that chemical formulæ are so frequently incorrectly given that a lengthy errata, mainly to correct these chemical faults, is required, but even this fails to cover all the sins of commission.

Many interesting substances, unfamiliar even to those engaged in the industry, are briefly described, such as the remarkable crystalline explosive salts resulting from the electrolysis of solutions of antimony with an antimony anode, the sulphides and selenides of nitrogen, the sulphide of carbon C_3S_3 , which compares with iodide of nitrogen in sensitiveness. In dealing with the explosive nature of compressed acetylene, the author states that its use has had to be abandoned in view of its explosive character, yet by the simple compression into steel cylinders containing porous blocks saturated with acetone, acetylene is now a valuable commercial product, and is largely employed in conjunction with oxygen for cutting steel plates, welding, and other purposes where a high temperature is demanded.

The author's connection with mining ensures that the application of various explosives for blasting purposes, submarine blasting for the removal of obstructions to navigation, including sunken vessels, is

fully treated, and many of the testing galleries employed for investigating the safety of explosives in coal mines are described. Many suggestions for the substitution of perfectly safe bodies in lieu of true explosives for this purpose are referred to. Among these may be noted the use of quicklime and its expansion on slaking; cartridges charged with liquid carbon dioxide or oxygen; but one of the most interesting methods was that introduced by M. Linde for the use of liquid air, in some cases a paper cartridge filled with kieselguhr and saturated with petroleum was then dipped in liquid air, the firing being carried out by a Bickford fuse or fulminate detonator. When the Simplon Tunnel was commenced in 1899 several attempts were made to utilise the explosive force of liquid air mixed with flour for blasting the rocks, but with unfavourable results. Liquid air alone, in metal cartridges, has also been tried for bringing down coal, but the author concludes that it does not seem an economic success.

Of more general interest is the important question of modern smokeless powders as propellants for military purposes. The Powers are fairly evenly divided in the choice between a gelatinised nitrocellulose powder or a nitrocellulose-nitroglycerine colloid. At one time the majority favoured the simple nitrocellulose powder, which is still retained by France and Russia, whilst Great Britain remains faithful to cordite, and Italy to ballistite. Germany may be said to be in a transition stage, for whilst employing a nitrocellulose for field guns, for the larger naval weapons a powder very similar to our modified cordite is employed.

All have had troubles to face with premature decomposition in magazines, and especially France. At Saigon in 1897 a quantity of poudre B ignited without setting fire to some black powder stored near by. 19,500 kilogrammes of this same powder had burnt with little damage in the previous year at the Saint-Médard factory, but the *Jena* disaster will ever be most prominently associated with this particular explosive, to which, in the author's opinion, it was wrongly attributed, whereas the special Commission appointed to inquire into the cause of this disaster believed it to be due to spontaneous decomposition of poudre B.

The instability of smokeless powders has led to the introduction of "stabilisers," the action of which is to absorb the oxides of nitrogen resulting from decomposition, which oxides, if present uncombined, greatly accelerate further decomposition. The author mentions a number of these, which include urea (American powder), diphenylamine (ballistite and the French powder BBo, first introduced after the *Jena* disaster), amyl alcohol (in the most recent French powders, AM₂ and AM₃), which appears to give excellent results. In cordite the vaseline acts as the stabiliser, although originally introduced for quite other purposes. It does not follow that for powders containing both nitroglycerine and nitrocellulose two stabilisers, one for each constituent, should be provided, as the author appears to think necessary.

Summarising the question of relative stability of the

two classes of propellants the statement is made that gelatinised nitrated cottons possess more stability than the nitroglycerine-nitrocellulose powders, and although the velocity of the projectile is lower for the same charge they have marked advantages in lower temperatures on detonation, less erosive action on the rifling of the guns, and give less smoke. In view of the troubles experienced with simple nitrocellulose powders, the claim of their superior stability, *per se*, to cordite is open to question.

On the whole the volume will be found a useful work of reference on the composition, manufacture, and application of explosives for practically all purposes. It is more essentially a book suited to the requirements of the engineer or mining expert, and would not afford much information to the chemist or those engaged in the manufacture of explosives.

J. S. S. B.

A STATE MEDICAL SERVICE.

The Dawn of the Health Age. By Dr. B. Moore. Pp. ix+204. (London: J. and A. Churchill; Liverpool: The Liverpool Booksellers' Co., Ltd., 1911.) Price 3s. 6d. net.

THIS is a remarkable and noteworthy book, powerfully written, and very convincing on most of the points raised. Its aim is to demonstrate the necessity for entirely remodelling the present system of medical service, in the interests of the whole community. It goes far to show that hundreds of thousands of lives and millions of money could be saved annually if diseases were attacked on more scientific principles; and the main theme is that we allow diseases to invade and enfeeble us, and then make an attempt (often a poor one) at cure, instead of concentrating our efforts on prevention.

The first chapter is headed, "How we tinker with disease instead of stopping it." Therein it is pointed out that concerted, statesman-like action is demanded. The present undisciplined mob must be converted into a disciplined army; and there are signs foreshadowed by legislation dealing with some of the great problems of social reform, commencing with invalidity insurance and reform of the Poor Law, that we are turning in this direction. The organised army of doctors would cost the nation from eight to ten millions a year—an amount which is at present exceeded, but in a nationalised medical service the money would be paid through different channels. Under the new *régime*, medical treatment would be as free to everyone as is the education of to-day, and everyone would be bound to accept medical treatment in his own interests, just as to-day he accepts the education of his child. The author estimates that tuberculosis costs the country 16,000,000*l.* a year, and that it can be eradicated for an expenditure of less than 10,000,000*l.* a year for ten years, further expenditure almost stopping at the end of that period. He further maintains that tuberculosis and preventable infantile mortality together cost us more than double the price of an effectual national service for their prevention.